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ABSTRACT

This monograph outlines the experiences of one school district when it acquired a computer capability. The document should prove useful to other school districts or educational institutions involved in the process of deciding how best to utilize computer technology. The study observes and documents the procedures commonly used by most schoolmen as they make decisions about computer technology in the schools. It addresses itself to such issues as computer hardware, administrative personnel, inservice training, and implementation. It discusses a step-by-step approach by which a computer capability can be established and then later expanded. An organizational chart showing the relationships among computer personnel and the relation between personnel and the computer facility as they exist in the subject school is included. (Author/DN)

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THE COMPUTER AND THE SCHOOL

The Results of a Case Study

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PREFACE

The public schools of Barrington, Rhode Island with funds from the Educational Facilities Laboratories, Inc. and staff from the New England School Development Council have been responsible for the development of this monograph. It is hoped that the experiences of Barrington will prove useful to other school districts or educational institutions involved in the process of deciding how best to utilize computer technology. It is clear from this monograph that decision-making in this area is not easy, but requires the thorough and comprehensive planning on the part of many.

Our experience with other school systems suggests that with the acquisition of hardware, one's problems do not cease. To utilize effectively this technology requires the continuous collaboration of many personnel who are willing to share what they have already learned.

NESDEC wishes to acknowledge the complete and untiring cooperation of Ian A. Malcomb, Superintendent of Schools, Barrington, Rhode Island, the members of his professional staff and the Barrington School Committee. Special acknowledgement must also be given to Charles R. Leonard, a former NESDEC staff member who was chiefly responsible for our work on this project. To the countless others who have cooperated in various ways, both in the conduct of this project and in the preparation of this monograph, we say thank you.

John R. Sullivan, Jr.
Executive Secretary
NESDEC

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INTRODUCTION

For some years the Barrington, Rhode Island, school system has made use of the computer in its work. This use began in the area of administrative data processing when Barrington joined the NEEDS project, and through them received computer produced report cards, students' schedules, attendance reports, and the like.

In 1965, Barrington added a small computer facility to its high school permitting it to offer instruction in certain aspects of computing to interested students. One such aspect fell within the business education department where students were taught to program, and to operate a computer. Another area was mathematics, where the computer served students as a problem-solving tool. A general course introducing the theory of computers was also offered.

On the face of it, Barrington had gone far in its use of the computer as a facility in its schools. However, as more and more students became interested in computers and computer technology in the course of their studies, Barrington's small computer facility soon became woefully inadequate. Indeed, the Superintendent of the Barrington school system, together with certain members of his staff, became aware of this particularly acute problem when they made an assessment of their use of computers. They were troubled by two things. The first and most troubling thing they discovered was that comparatively few of their students and faculty had access to the computer; that is, while Barrington had recognized the potential of the computer in its schools, it had begun to realize that potential for just a small number of people. Barrington was troubled, as well, by the fact that even though its use of the computer facility in the area of instruction was limited, and that the services provided by NEEDS were restricted to just three of the many administrative applications available—mark reporting, student scheduling, attendance accounting—Barrington expended about $30,000 each year on its limited computing activities.

Consequently, the Superintendent and members of his staff were forced to conclude that even though their use of the computer was a relatively modest one, it was costing more than a modest sum of money to do the job. Thus, as they analyzed the situation and came to think about extending their appli-

cation of the computer, they became convinced that new arrangements had to be made.

But the clarity with which Barrington saw the pressing need for such new arrangements was matched by a cluttered, barely visible sense of what the arrangements ought to be. For instance, one reasonable alternative could have been to take over from NEEDS the chores of administrative data processing, and with the money saved to broaden the instructional use of the computer. But what about the headaches of administering one's own computer facility or the frustrations of "down-time" so characteristic of many computers, or the heavy burden of local software development? Could the cost of the computer be justified? Would the distractions from other worthwhile educational innovations be too great? What are the true costs of such a reasonable alternative, and would they become too great a price to pay?

There was also the issue of student access to the computer. Should it be in batch mode, allowing large numbers of students, faculty, and staff to use the computer in their work, or should Barrington acquire a time-shared computer, thereby limiting the simultaneous users, yet increasing the opportunity for immediate turn-around, on-line access, and the use of interpretative languages. What would be the educational reasons for the choice? Then, whatever the choice, how would administrative and instructional demands compete for computer time? How would Barrington deal with conflicting demands? Would one computer be enough?

Clearly, the matter of settling on a computer facility suited for the Barrington needs was complex in nature and presented many issues mostly unresolved even by the experts. Indeed, Barrington admitted that the problem was greater than it was equipped to handle. In his letter to Educational Facilities Laboratories, Inc. (EFL), calling for a study related to computers in the schools, Barrington's superintendent stated: "We cannot avoid the issues. We must face them. Yet with our lack of experience and knowledge in this area we cannot face these problems alone. We need help."

Recognizing its situation, Barrington turned to NESDEC for assistance. Initially Barrington asked the question: "Given the current state of computer usage in the schools, what now is our position relative to this current state?" To answer this question NESDEC proposed to study the computer requirements of the Barrington school system by means of an investigation which would:

1. Gather, organize and interpret data related to quality, comprehensiveness, and relevance of the programs and data processing activities presently offered and/or purchased from outside vendors.
2. Make an analysis of equipment system alternatives in the light of present and future data processing requirements.
3. Make recommendations designed to provide direction and impetus to the realization of a high quality data processing environment.

4. Provide consultation on the acquisition of computer hardware.

The study observed and documented the procedures commonly used by most schoolmen as they make decisions about computer technology in the schools. It addressed itself to such issues as computer hardware, administrative data processing services, and student access. It considered such areas as personnel, in-service training, and implementation.

The result of this effort was a long term plan for the computer facility in Barrington which is now well on its way toward becoming reality. But the plan for Barrington was not the only result of our study, for in the process of conducting our investigation it became clear that many school systems other than Barrington were facing the same sorts of problems, and that what was learned in the Barrington experience might be applicable to other school systems as well.

Thus, the present document extrapolates from the Barrington experience and addresses itself to those broad issues which confront most school systems as they move towards up-dating or acquiring a computer facility.

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THE SUPERINTENDENT'S DILEMMA

The use of computers and computer technology in the schools is becoming a matter of increased interest and concern to many superintendents. For the most part, however, schoolmen find that introducing computer technology into the school system is a confusing endeavor, and one fraught with numerous complex problems.

One major problem is the pervasive semantic difficulties which arise in talking about computers. Much is said about the various systems currently available to the schools, especially in the secondary schools, such as total information systems and education data processing systems. The literature abounds with articles about CAI, CMI, MIS, and the [illegible]. Adding to these complex areas of discussion is the foreign, confusing computer terminology of the computer salesman. He talks about bits, bytes, random-access, batch and remote batch processing, and other areas equally confusing to the superintendent. Consequently, the superintendent is presented a perplexing situation, and as such he and the computer vendor can scarcely converse, let alone reach a common understanding.

Because of this communication problem between the superintendent (a non-technical person) and the computer vendor (primarily a sales oriented person trained to have a technical vocabulary), the superintendent has few ways of assessing the claims put forth by the various computer vendors, whose positions are understandably biased, since each simply wishes to sell his computer to the school system. Unlike the housewife or member of Diners Club there is for the superintendent no "Seal of Approval" for which to look, invariably the superintendent along with the school committee must consider the purchase or lease of equipment in the midst of the most confusing claims, frequently without knowing even what are the most appropriate questions to ask. As one superintendent who was involved in the process of acquiring computer hardware admitted, "I didn't understand a thing they (the computer vendors) were talking about."

Just as the superintendent is frequently too lacking in knowledge about computers to participate with assurance in the establishing of the computer facility, so too are the members of his school system who will eventually be involved with the computer and who must make proper assessments of its

usefulness. Many of them operate with fears and misconceptions of computer related work which prevent their engagement with the computer enterprise, and which prevent its potential from being realized. By the same token the personnel who will be responsible for the administration of the computer facility itself are frequently knowledgeable only about unit-record equipment and punch card applications for administrative data processing. They invariably lack the knowledge and the broad understanding about the full spectrum of the relationship between computers and education that would enable them to organize and administer a dynamic and responsive computer facility in the school. Thus, the problem of knowledge that faces the superintendent also faces the members of his system who will use the computer facility and the members of his staff who will be responsible for the administration of the facility.

The problems of knowledge crystallize specifically around the issue of establishing computer related objectives for the entire school system which would ensure the coherent growth and development of the facility. But because knowledge about the potential of the computer seldom informs the planning of the facility, the wide applicability to the school system is largely unknown and unassessed when plans are being formulated to acquire computer hardware. The result is that when those segments of the school system which were not aware of the potential of the computer for them do become aware of it, and wish to make demands upon the facility, the facility is unable to meet those demands.

Historically, the computer facility in the schools frequently grows without aim or direction. Traditionally, the computer facility in the school was utilized to prepare students' schedules, report cards, attendance reports, and the like. More recently some schools have used the computer to provide computer aided instruction, thereby providing the capacity for "individualized instruction." Consequently, some schools have multiple computer facilities. One computer attends to the administrative data processing while the other computer provides for student access. Yet both computers may sit idle for a major portion of the day resulting in a tremendous loss of potential and a squandering of resources.

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RESOLVING THE DILEMMA

It is no revelation, of course, that the confused, often chaotic circumstances that confront the superintendent who contemplates the use of computers in his schools are best approached and most often clarified through the use of some well thought out, systematic procedure. Typically such a procedure begins with the analysis of the contexts within which the school system desires to apply computers. It proceeds through the synthesis phase where the various areas under investigation that have been analyzed and put back together, thus forming a new picture of the total school system's computer related requirements. Finally, and after the analysis and synthesis phases have been completed, there comes the implementation of the plans with respect to the overall computer related objectives.

Analysis is the separation of anything into its constituent parts or elements. When applied to the process of computer acquisition, particularly in the educational setting, analysis involves a review of the entire educational process as well as the administrative practices presently ascribed. Analysis provides the opportunity to divide the total operation of the school facility into logical and workable units thereby providing information which, when properly evaluated, permit us to see if there exists suitable alternatives to improve the operation of the entire school facility. Analysis affords the opportunity to establish study objectives and assists us in determining potential for further study. Moreover, analysis is essential in the process of determining the school system's computer related administrative objectives as well as determining the computer related instructional objectives. The reader should see the importance of separating the school system into logical, workable parts prior to the acquisition of computer hardware. To be sure, each administrative staff member, each faculty member, each member of the student body will have unique demands on the computer facility. Thus, it can be seen that these potential users become essential parts of the analysis phase. Only after these views are made known should a school system proceed in the computer acquisition process.

As stated, the analysis phase separates the school system into logical, workable parts which can be examined. The complement of analysis is synthesis. During the synthesis phase we begin to combine and build those parts into a

new postulated system. These elements or parts are the views of the potential users and their demands relative to the use(s) of the computer in the educational setting. In the synthesizing phase the school system should be developing alternatives to existing practices and exploring the various uses of the computer in the schools. Further, and most important, is the refining of the computer related objectives together with the evaluating of computer hardware that will permit the school system to attain those objectives. This phase initiates the establishing of computer hardware specifications. These hardware specifications must ensure that the educational specifications can be matched. The school system that has proceeded through these two phases—analysis, synthesis—is now ready to plan for the installation and implementation phases of computer facility development.

The installation phase takes into consideration the development of a plan that includes such items as: the computer's delivery date, the air conditioning requirements, the electrical requirements, not to mention the space requirements for the computer hardware. The installation plan assumes that all is in readiness for the expected delivery of the computer. The computer room has been properly designed, air conditioners have been installed, etc. Implementation, on the other hand has many more implications. Briefly, the implementation phase takes into consideration the entire scope of the school's computer related objectives. Implementation begins with the installation of the initial computer hardware and proceeds through the planning necessary to provide for future computer facility growth. Indeed, the problems of computer facility growth and expansion within the school system will receive considerable attention in the following pages.

NESDEC's experience in Barrington not only showed the variability of the systematic approach, but also demonstrated that while many factors influence whether or not the approach will be successful, it is the activities in the analysis stage which largely determine how well the computer facility will serve the school system.

The activities of the analysis stage, moreover, are ensured of serving the other stages when the problems are addressed in a coherent fashion. What follows are the tasks which the Barrington experience has shown to be crucial to the proper analysis of the school system's computer related needs.

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APPLYING THE PRINCIPLES TO THE CHRONOLOGY OF ESTABLISHING A COMPUTER FACILITY IN THE SCHOOLS

Having discussed the systems analysis approach to introducing computers and computer technology to a school system, it is now possible to establish a chronology of events which would constitute the entire approach.

Given the potential of systematic procedures to solve the problems arising from the acquisition of computer hardware, and given the financial feasibility, it is possible to meet the school system's demands for "action" regarding its computer facility by engaging in a Three Phase Plan for implementation.

THE THREE PHASE PLAN

The Three Phase Plan proceeds from the initial discussions to providing computer hardware necessary for a sophisticated, open-ended computer environment. It begins by establishing a Council on Computer Facilities and proceeds through an in-service training program and analysis procedures. Moreover, this Three Phase Plan proceeds from the establishing of a minimally configured computer facility to one of increased capacity where the facility will have the capabilities of multi-programming, thus providing for a dynamic computer environment characterized by simultaneous administrative and instructional use and by a variety of potential applications. This Three Phase Plan takes into consideration the numerous problems that the superintendent encounters when introducing computers into his school system and as such offers three stages of computer hardware implementation and systems development. Initially, the computer hardware provides the capabilities of limited in-house administrative data processing and limited student access. Then the administrative data processing capabilities are increased with the addition of interactive on-line terminals. The addition of terminals simultaneously provides dramatically increased student and teacher interactive access. Stage three of development includes the addition of still more sophisticated hardware and higher level languages thus providing the open ended computer environment.

Needless to say, the school system that follows the NESDEC plan for com-

puter facility development should be capable in terms of being familiar with the computer of introducing the computer hardware suggested in Phase Two of development, namely the provision of on-line interactive terminals needed for increased student and teacher access.

We assert that the best means of achieving the benefits of a computer facility in the schools is to ensure that the potential users of the facility have had exposure to computers and computer technology prior to making the decision to acquire computer hardware. Further we must ensure that the introduction of computers and computer technology into the school system have a viable plan for implementation, that it has planned system development features that provide a high degree of flexibility, that it possess a communications network that permits the free flow of ideas, and that a constant, effective in-service training program be initiated that would permit students, faculty, administrators, and staff to gain appreciation for the facility. It is possible, as well, to ensure that these requirements are met by construing them as tasks to be performed. Thus, each phase of this plan will be seen to consist of a number of tasks.

Phase 1

TASK I *Exploring the Possibility of Establishing a Computer Facility*

For all schools considering a computer facility a number of preliminary activities are required in order to ensure that the decision is based on accurate information and the objectives of the facility can be attained. Initially, the Superintendent should establish a Council on Computer Facilities.

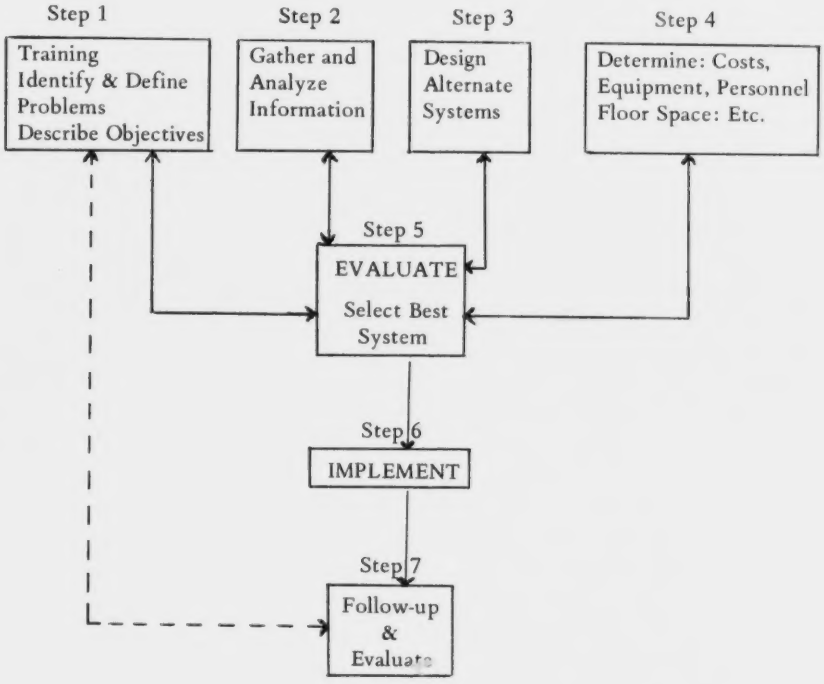
Nothing approaching a "total system" in terms of computer usage in the schools will be achieved without first looking into the computer requirements throughout every part of the educational environment. The potential users of the computer facility—teachers, students, staffs, and administrators—must all be involved so that the structure that eventually emerges will be responsive to the computer demands from these various segments.

Traditionally, the responsibility of the computer facility has been thrust upon the school principal or his designee, and the instructional applications into the hands of the mathematics or business departments. Such a situation retards the growth and expansion of the educational computer facility, even one with minimal hardware configurations.

Specifically, schools will find that its computer activities must be looked at as a viable component of the school system, and that its relative newness should not preclude its being organized, budgeted and planned accordingly. Indeed, the key to obviating the problem is to provide for proper direction, a direction which would probably be best accomplished by the forming of a representative Council on Computer Facilities.

With the forming of such a Council, the school would charge certain individuals with the responsibility for its computer facility. The council would

recommend the procedures required to attain the objectives of the entire school system as they see the computer to be useful in attaining these objectives. They would plan for each phase of the facilities' development, including the planning necessary for new and advanced applications for instructional purposes as well as administrative applications, and they would establish the communication network among the administration, faculty, staffs and students through well devised in-service training programs.



COUNCIL ON COMPUTER FACILITY
FUNCTIONAL FLOWCHART

The Council on Computer Facilities should be comprised of representatives from all those areas which will be affected by the computer. Because the council will concern itself with the applicability of computers to the instructional process and the administrative data processing requirements as well, it is conceivable that a representative from the business world would be a valuable asset to such a council as it tackles the problems of administrative

data processing. The need for such broad representation is essential if schools are to establish dynamic computer facilities. Moreover, the council will assist in determining the scope of computer technology in the schools as it relates to the setting of proper, well thought-out, computer related objectives. Further, such a committee obviates many of the traditional administrative problems that attend to the development of computer facilities in the schools. It is in no way controversial to assert that a combination of inadequate administration and organizational problems have led to the many difficulties that have attended the installation of computer facilities within the school systems.

TASK 2 Providing In-Service Education

Soon after the forming of the Council on Computer Facilities, plans should be made to provide the council with the facility to gain experience with computer technology. This exposure to computers is an essential element in the computer selection process. It is essential because the council must ensure that as many as possible of the educational objectives (yet to be established) of the entire school system are attainable. It is essential because the council must integrate those educational objectives with computer technology. Because of these essential items the need for a training process that addresses the problem of the co-existence of man and machine in a single, mutually dependent mix becomes particularly acute.

However, experience has shown that such training when directed exclusively to the theoretical-philosophical aspects of the relationship between man and machine has largely failed in its objective of bringing the two together, and in fact, has done much to keep them apart. Now it is true that no user of the computer—student, teacher, or administrator—should be unaware of how interaction with this technological device radically alters his whole conjunction with his environment, but it can also be seen how emphasis in these aspects of computer usage alone can do little more than increase the mystique that surrounds computer related work and thus leave the potential user quite paralyzed in the face of the overwhelming implications that begin to surface.

What may be more productive is to ensure that attempts at theoretical-philosophical orientation be balanced by practical, hands-on experiences with the computer itself. In fact, the most important component of the computer education process may be the actual and early exposure to, and interaction with, the computer. There is evidence that ingrained alienations and misconceptions people have about the computer are not displaced by the training itself. But the problem is not insurmountable, and it seems reasonable to expect that a computer education process which is not overly complicated and which allows the council to use the computer in a relatively short time can achieve success.

It becomes obvious from the preceding discussion that the Council on Com-

puter Facilities has a very important role in determining the computer related objectives of the school system. Certainly, in order to properly assess the computer's role in these various areas, the council should have a pre-computer training program. Such a program might include the use of the BASIC computer language. The BASIC computer language is the most easily understood problem-solving language currently available. BASIC is expressed to the computer in conventional English and simple algebraic notation which make it well suited to a concise expression of a variety of situations and problems. Indeed, there is considerable evidence that with minimal formal classroom instruction one can begin to program in a relatively short period of time, usually no more than two days.

Unlike some computer languages that were originally designed for computational applications in mathematics, science, and engineering, BASIC provides the user with the experience of using the computer as a problem-solving tool. Because BASIC is designed to provide on-line interactive access to a central computer, it is necessary that teletypes, perhaps portable teletypes, be made available to the Council.

TASK 3 Providing a Resource Agent

In order to provide for the proper introduction of computers in the schools, it is clear that the council will need some special assistance from a computer professional. As a general rule, when the required talents are available, say at the local level, for the teaching of the BASIC computer language, it might be advantageous for the school system to avoid outside assistance. However, the school system will probably need some assistance in the writing of computer hardware specifications. Moreover, the use of outside resources may be required to analyze the vendor bids in order to ensure that the specifications, as written, have been properly executed.

Though outside resource personnel have a vital role to play, the school system that places a heavy reliance on such expertise may, in fact, reduce its own involvement. Because the Council on Computer Facilities has considerable potential, the school system should not delegate the responsibility entirely of training, planning, objective setting and implementation to the resource agent. While it is true that such a person can assist in the areas as noted, it is also true that once brought in, school systems have a tendency to become dependent upon the agent. When this happens there then becomes little reason for the schools to develop their own expertise and capacity to evaluate meaningful alternatives to computer related requirements. There is thus no equity in terms of staff participation.

However, some schools must recognize that they just do not have the necessary staff or individual expertise to conduct the training program as suggested earlier. Consequently, the school system should face the trade-off of delaying the computer acquisition process until such time as arrangements can be made to include the expertise necessary to provide the essential training.

Because such resource agents charge for their services, there is a tendency on the part of the schools to look for alternative solutions to the problem, namely, to rely upon the computer vendor, who, for the most part, does not charge for his services. But as was demonstrated earlier this is seldom a wise alternative.

The importance of the Council on Computer Facilities and its responsibilities for the proper planning and implementation of the school computer makes it difficult, if not impossible, to delegate such authority to outside agents. By facing these responsibilities the school system achieves valuable experience in developing the expertise necessary to undertake additional steps necessary to achieve the school system's computer related objectives. It also provides a foundation for the dialogue necessary to obtain information and understand more fully the issues regarding the complex problems of computer hardware acquisition.

TASK 4 Initiating a Systems Design

Despite the interest that schools have in computers to assist them in their work, it is quite clear that the actual development of integrated computer services by school administrations is woefully inadequate. This development is inadequate because the normal, routine, administrative data processing activities tend to develop in a sequence corresponding to each school's priorities. This piecemeal approach invariably results in a collection of data processing programs that contain many duplications of data formats and processing steps. The predictable consequences of this are re-invention, duplication, and a tendency to meet immediate problems rather than to develop a more thorough, sophisticated data processing system.

To eliminate negative consequences, schools must recognize that transition from long standing procedures and more rudimentary systems to a higher level of sophistication will require much planning and communication. And that, indeed, a local systems design effort must be initiated, as implied earlier, by the Council on Computer Facilities.

One of the most important aspects of the systems design is the determining of the various data bases that should be constructed by the school system. Among these are:

Pupil Information–	Mark reporting, test scores, attendance information, census information, parent information, guidance information (comments, teacher evaluations, student attitudes, interests, plans, extra curricula activities).
Personnel–	Staff status (qualifications, experience, accomplishments), financial records, retirement fund.
Budget Accounting–	Current expenditures, projected expenditures, anticipated revenue, budget analysis, payroll, accounts

	payable, purchasing, program cost analysis.
Inventories and Facilities–	Current projects, maintenance scheduling, status reports, contracted services, projections, inventory reports, supplies, materials/supplies on order.
Auxiliary Services–	Transportation scheduling, cafeteria accounting, student passes to football games and other extra curricula activities, PL 874 analysis.

A systems development effort, if the concept of a properly designed record of timely and accurate information is accepted, would provide the data base for the school's facility. With this approach, a permanent record or data file would be constructed for each area of application. For example, a permanent record in the data file would be constructed for each student, and as the student progressed through the various grade levels, information would be recorded and updated and decisions would be made relating to a student's progress. Thus, as teachers, counselors, or principals desire to know how a student is progressing, or towards what problem areas or resources he should next be directed, the student's master file is searched for information and displayed for the viewer within seconds. Each area of application noted above would have a similar base which would be updated and accessed in the same manner.

TASK 5 Anticipating Instructional Implications

Over and above the anticipating of administrative applications there is the considering of the instructional implications which must be addressed in Phase 1 in anticipation of later development of the school's computer environment.

There is some evidence that the computer can be harnessed to direct the instruction of pupils by managing the learning process. There are visible experiments being conducted throughout the United States which are aimed at perfecting an approach to, and adapting instructional material to, the computer. These experiments and the state of the art change so rapidly that an adequate appraisal at the present time is unrealistic. Moreover, since each program has been designed for a particular application, it is extremely difficult at this point to conclude that any one program is unequivocally better than any other. The issue of harnessing the computer to manage instruction becomes even more involved when the areas of curriculum development, teacher-pupil relationships, size and function of each school unit, class size or groupings are examined. It is not within the scope of the study to make recommendations about this particular aspect of computer usage in the schools, but the fact still remains that schools must determine the extent to which instruction shall be turned over to its computer facility. The following list presents some areas to be considered:

1. Definition of purpose for instruction.
2. Definition of instructional tasks.
3. Determination of effectiveness.
4. Determination of equipment, staff and facilities.

It is possible to say, however, that a decision to utilize the computer as a drill-and-practice device in no way plumbs its full potential as an instructional medium. This potential is more likely to be realized if the computer facility is seen as a resource center, easily accessible to students for interactive problem-solving in support of various academic subjects.

TASK 6 Organization and Administration

Inadequate administration and organizational problems have combined often to create difficulties that have attended the installation of computer facilities within any school system. Traditionally, the responsibility of the data processing functions have been thrust upon the principal or his designee, and the instructional applications into the hands of the mathematics or business departments. Even with minimal configurations, such a situation, while accomplishing the routine data processing tasks, frequently diverts the principal and/or the department members associated with the matter from their other duties. Instructional applications, however, become static and, in most cases, never go beyond the mathematics or business departments.

This situation and this combination of administrative and organizational problems has, in fact, retarded the growth and expansion of any number of educational computer facilities. The fact remains that the principal is to administer and the teachers are to instruct the students in the particular subject matter. To be taken out of this environment and placed in the world of data processing is in most cases a disturbing experience.

Computer facility growth and expansion is restricted in the sense that this type of organization does not permit nor have imbedded in it the expertise which will ensure that software is written or systems design initiated. In such cases, the computer facility never emerges from its rudimentary stage, and becomes a frustrating endeavor for those schools involved. It becomes equally frustrating to learn that the computer facility is further restricted because its administration has not initiated a well planned, systematic form of in-service training for its faculty and staff which would permit the computer facility to expand into other schools within the system and into other areas of the school's curriculum.

All of these factors—the apparent lack of proper administration and organization, the apparent lack of proper planning, and the apparent lack of in-service training programs—lead us to the valid conclusion that the traditional education data processing centers established in most schools have been, or are, inefficient. The question of what effects a more complicated

computer facility would have on the present administrative pattern is staggering. With a more complicated computer facility, more time would be required of the mathematics or business departments, and even greater expertise would be required to ensure the facility becomes a dynamic entity within the school system.

Moreover, when a new facility is acquired the central administration's problems are compounded. The problems for the central administration occur when the facility expands to include other schools within the system. It will be confronted with curriculum and material's development, evaluation of the facility, future expansion, additional staffing and other such problems. The effects of a more complicated computer facility will be felt by each student, teacher, and administrator within the system. Thus, we conclude that the traditional view of organization and administration of data processing facilities must be rejected as the schools replace an old, outmoded computer with a more complicated piece of hardware.

Specifically, schools will find that computer facilities must be looked at as a viable component of the school system, and that its relative newness should not preclude its being organized, budgeted, and controlled according to the same guidelines as other school departments. The key to obviating the problems in the establishment of a dynamic computer facility is to provide for the proper administrative direction, a direction which would probably be best accomplished by the establishment of the position of a Director of Computer Facilities.

With the establishment of the position of Director of Computer Facilities and the forming of the Council, schools would charge certain individuals with the responsibility for its computer facility. The Director and the Council together, would recommend policy and establish procedures for the computer facility as it relates to the entire school system. They would plan for each phase of the facility's development, including the planning for new and advanced applications for administrative and instructional purposes, and would establish communication networks between the administration, faculty, students, and staff, through in-service training programs.

Director of Computer Facilities

Job Description. The Director of Computer Facilities should have the responsibility to plan, organize, coordinate and supervise the activities of the school's computer facility. He will be responsible for project plans and methods of evaluating the applications of the computer facility to educational goals such as developing a model system, evaluating and analyzing the system specifications, conducting and supporting simulation studies, and exploring new applications to the school's data processing and instructional problems. He will arrange and conduct meetings with the advisory council, establish and maintain a central library of materials relative to education data processing systems and equipment, provide consultation to the superintendent

and other department heads on the application of the computer facility to their departments, conduct in-service training programs for the school personnel, act as liaison agent between the schools participating in the computer facility.

Minimum Qualifications. The Director of Computer Facilities should possess valid administrative, supervisory and data processing credentials. He should have general knowledge of current developments in the education data processing field, methods and terminology. He should have wide knowledge of procedures, systems design, organization, administration and management, supervision and training. He must have the ability to plan, organize and coordinate a centralized data processing facility, speak and write effectively, and secure the cooperation of the school system's staff, analyze situations accurately and take effective action to ensure the objectives are attained. (See Appendix A—Organizational Flow Chart.)

TASK 7 Setting Objectives

A school system which has proceeded thus far through the tasks of Phase 1 has by that fact alone made educational philosophy and environment an essential element in its view of the computer. The superintendent that has established the Council on Computer Facilities and made provisions for their training together with the assistance of a resource agent and proper computer facility staffing has greatly increased the likelihood that properly defined computer objectives can be formulated.

TASK 8 Contracting for Acquisition of a Computer Facility

The school system desiring to acquire a computer facility must write the specifications and go through an extended, complicated, and sometimes frustrating experience of bid specification analysis. These specifications and the procedures pertinent to its use will be considerably more than just exercises. They will, in fact, become the tools which will provide better systems, at lower cost, for a school system.

Properly executed, the specifications set forth clearly the desires of a school system embarking on the complex business of computer acquisition. It is important that the intended equipment be fully documented and understood by the school administration and the potential vendors. Thus, the specifications document comes to communicate the desires of the purchaser to various manufacturers and each knows exactly what is intended.

A set of specifications must reflect the educational objectives of the entire school system with regard to the computer facility, and must set forth the specific requirements of that configuration which will be necessary to accomplish those objectives.

With the writing of the specifications for the computer facility, especially one that involves administrative data processing and instructional applications on a single computer, it is necessary to remember that certain unit-

record equipment may be required as supporting equipment.

With the installation of a computer facility in the schools, most unit-record configurations will require modifications. Some schools may require additional equipment to support the computer facility while others will require less.

Using a standardized format, the writer of the specifications should be concerned with four basic areas of specificity. They are: the general section, the section that defines the scope of the specifications, the equipment component specifications and in some cases a proof of performance section.

The general section should contain the school system's legal and business policies that must be considered by the potential vendor. These facts should include such details as procedures to follow when submitting proposals, terms of agreements, compliance with building codes, requests for in-service training, manuals, etc.

The general section further defines the scope of the specifications and is used to set forth the type of computer hardware or system that is to be provided. It establishes the guidelines and the details for the performance of the various units or devices. Moreover, it outlines the responsibility of the vendor during the negotiations. In this section the specification writer should set forth exactly how the equipment will be used together with complete information related to the school system's objectives, the school system's obligations, and the vendor's responsibility.

The next section—system specifications—should define the system's operational parameters in clear, concise technical terms. This section may include the accepted installation practice and provide definite details related to the minimum acceptable system desired by the school system.

The equipment component section should define the specific operating and technical characteristics of each component included in the hardware and software specified in the preceding sections. Since this section deals with the technical data of the hardware components it may be desirable to list only those components on which major emphasis must be placed.

Finally, the proof of performance section is used to define the procedures to be followed by the vendor to assure the school system that the computer hardware supplied does, in fact, meet the requirements and the specifications as established in the preceding sections of the specifications. This section should establish the testing procedures for the hardware and software to be supplied. Moreover, the responsibilities of the various parties and the performance tolerances of the system should be specified.

While this is a simplified specification outline, the complexity of each section will be dependent upon the level of sophistication and the complexity of the computer hardware being considered. If, for example, the school is purchasing specific components, we may omit the overall systems specifications section. Also, the proof of performance section may be omitted.

SAMPLE COMPUTER SPECIFICATIONS

General

1. Vendors' proposals for the following computer related systems will be received at the Sample School Committee offices on (date). Proposals (bids) will be publicly opened at (time) on the above date.
2. Sealed bids are to be addressed to the Chairman, Sample School Committee clearly marked "Bid for Computer." Any or all bids which are inadvertently opened prior to the above time and date because of improper addressing or unmarked will not be considered.
3. All bids should conform in all respects to the sample school district purchasing and/or leasing policy. A copy of the policies is appended to this invitation.
4. All prices will be FOB.
5. Terms of agreement shall be calculated to project 1, 3, 5 and 7 year rental or lease purchase charges. These charges will include monthly maintenance charges on the initial hardware configuration.
6. All equipment is to be warranted for parts and service for (X) years following acceptance by the Sample School Committee.
7. Vendor may take exception to any portion of the specification. Such exception must be made in writing and submitted with the bid. If none is submitted the bidder agrees to be bound completely by the specifications as written.
8. The Sample School Committee is not responsible for typographical errors within the specifications.
9. The Sample School Committee reserves the right to accept or reject any or all bids.
10. The Sample School Committee reserves the right to accept or reject any or all bids and to waive any and all irregularities or informalities as deemed necessary for the sample public schools or the town.
11. The Sample School Committee has the right to evaluate each proposal and accept the bid which best serves the interests of the sample public school, noting the accepted bid may not be the lowest dollar bid.

Scope

1. Purpose of Specifications

   a. The purpose of this specification is to provide a basis on which the Sample School Committee may request quotations related to the acquisition of computer hardware and associated computer software support.

   b. The scope of this specification is to define the minimum requirements of the Sample School Committee in terms of educational and administrative data processing services.

2. Minimum Hardware Requirement

   Central Processor must be capable of multiprogramming functions.

   Auxiliary Devices

   Tapes – Magnetic IBM compatable
   Disks – Magnetic
   Printer – 600 lpm
   Reader – card
   Punch – card
   Operator Console

   Software Requirements

   Batch computing capability in the following languages:

   FORTRAN IV
   COBOL
   RPG
   ASSEMBLY

3. Educational Administrative Requirements

   a. Assignment of pupils to classes or scheduling of the Sample High School (approximately 1500 students).

   b. Mark-reporting services that will interface with the current policy of the Sample School Committee

   c. Automated attendance system that will interface with and be acceptable to the State Department of Education.

   d. A test scoring and analysis program that includes such items as:

      I. Item analysis
      II. Student profile
      III. Class roster
      IV. Frequency distributions (as required)
      V. Pressure sensitive labels

4. Other Requirements

   a. For all such systems complete documentation and user manuals shall be provided.

   b. Systems software so provided should be fully operational and employed by other school districts.

   c. Proof of performance shall be a required facet of these specifications and shall include benchmark tests of hardware and software.

TASK 9 Analysis of Returns

After the potential suppliers submit proposals for the hardware configuration, it becomes the school system's responsibility to evaluate what has been submitted. The need for an in-depth analysis of any proposal cannot be overemphasized, and though mounting such analysis is not an easy task, the responsibility for it cannot be taken lightly.

Each proposal must be carefully reviewed, section by section. In this review the school must ascertain whether or not the vendor has made exceptions to the specifications or whether the vendor will supply the equipment as specified. In short, the analysis should conclude that the school system will receive exactly what it has asked for.

Needless to say, the proposals must be analyzed by those responsible for designing the system as well as those who were responsible for writing the specifications, and thus contrary to common practice in many school systems, the proposals cannot be received one day and accepted and contracted the next day.

The goal of the vendor analysis process is to choose the vendor that can best satisfy the school system's requirements as established by the objectives and communicated to the vendors by the specification in the request for proposals. The specifications have thus become the selection criteria from which the decision is made to acquire the computer from a particular vendor.

Simply, the decision process, as it pertains to computer selection, can be looked at as similar to the recruiting of personnel. In personnel recruiting we should first have some idea of the task, or job to be done, before trying to define the qualifications of the person to accomplish that job. Suppose, for example, we have four candidates for a particular teaching position, and we must evaluate each individual. How best might we arrive at a decision based upon some selection criteria? One procedure we might consider is to place judgment weights on certain factors and evaluate each area separately. Generally, such a method has numerous stages and factors, but for simplicity we use three factors. The first task is to determine the decision criteria. Second, establish relative importance of each, and finally to rate each individual. In matrix form it appears as:

Individual		"A"		"B"		"C"	
Criteria Value		score		score		score	
Education	5	4	20	2	10	4	20
Appearance	4	3	12	4	16	4	16
Attitude	5	1	5	3	15	3	15
TOTAL			37		41		51

As one completes an evaluation of this type it becomes obvious that a number of value judgments must be made. It is true that an evaluation of this type is only as good as the judgment factors considered. However, such a method provides a constant framework for evaluating those factors and for pointing to specific areas where more appraisal is required. By using a similar method of evaluation, a school system could arrive at a choice of computer hardware and specific vendor. Consider the following:

Computer Vendor		"A"		"B"		"C"	
Criteria Hardware	Value	Score	Weight Score	Score	Weight Score	Score	Weight Score
Reliability	4	3	12	10	40	10	40
Compatability	4	4	16	10	40	7	28
Flexibility	4	10	40	10	36	10	40
Communication	4	6	24	10	0	9	36
TOTAL			92		116		144

This type of matrix could include many items considered in the decision making process as it pertains to computer systems analysis. The example adds the ratings given each computer under study and provides information about which computer has matched the specifications, which computer has certain weaknesses, and which computer has especially strong points. As with the personnel recruitment example, several value judgments must be made.

It is then necessary for the school system to hold a pre-award conference with the selected manufacturer, in an attempt to ascertain that each knows exactly what the other's intentions are in relation to the bid specifications submitted and the responding proposal. This pre-award conference permits a dialogue that will ensure that each party understands its respective position related to the specifications and requirements. The pre-award conference also permits the manufacturer to explain in full the operational characteristics of the equipment and to answer questions related to flexibility of hardware and software, delivery time and installation, and other such matters. Only after each party fully understands the implications growing out of their respective positions, and only after any deviations from the specifications and the proposal have been noted, can the contract be awarded.

TASK 10 Preparing the Site

Once the contract has been awarded for the acquisition of computer hardware, the school system must find a place to put it. Unfortunately, computers are harder to accommodate than people, but with a few guidelines and assistance from the selected vendor, accommodating the computer should not be a difficult task.

Soon after the contract has been awarded for the computer facility, the

manufacturer will be able to provide the school system with manuals and check lists to help with installation planning, and in some cases supply personnel to ensure that the computer room environment is properly constructed. Manufacturers are quite willing to lend their assistance during the planning stage and schools should not hesitate to call on such expertise. One issue that manufacturers will be concerned with is the amount of room available for the computer, the amount of room available for working space, for maintenance personnel, and for storage space for maintenance materials. They will also be concerned with the air conditioning and humidity. With proper planning for the installation, the school will be satisfied to know that its computer is in a dust free, air conditioned, humidity controlled environment and will soon be alive and well.

In determining floor space requirements schools should not lose sight of the fact that the computer facility will, in all likelihood, expand. It is suggested that additional considerations for expansion be considered before construction begins.

The final activity involved in the task of contracting for the acquisition of a computer facility is the actual leasing of the equipment. For example,

Phase 1, Hardware Configuration

July, 1971 –	Central Processor Unit	–	16K Bytes of Memory
	Card Reader	–	300 CPM
	Line Printer	–	450 LPM
	Disk Storage	–	8.4 Million Bytes
	COST per month	–	$1600.00

In addition to the basic hardware configuration, the computer facility will have the related computer manufacturer software available. The software provided will include the following:

Operating System
Utility Routines
Compilers
Assemblers

Also, computer software will be supplied by most computer manufacturers that will permit the school administration to initiate a data processing program that includes the more routine administration functions. Some of these software packages will include the following:

Student Scheduling
Grade Reporting
Budget Accounting
General Accounting

Each such system above must be examined carefully to ensure, for exam-

ple, that the grade reporting system computes Grade Point Average, or that the input is not restricted to alphabetic grades when, in fact, numeric grades are required, and so on.

TASK 11 Providing for Initial Applications

Some of the initial applications of a school's computer facility could be in the areas of mark reporting, student scheduling, and student access. A number of considerations attend the application of the computer to these areas and, therefore, it is necessary to ensure a smooth transition from present practices to an in-house controlled computer approach.

The term "in-house control" means that the school system has assumed responsibility for all those data processing and consulting services which may have formerly been provided by an outside bureau. The term implies that the school system has expertise in the operation of a properly organized computer facility. The term implies that the school system has enough consulting strength and knowledge of the functioning of software support programs that its computer facility can, in fact, become the means by which the school system can provide a full range of computer services for itself.

Rarely do such in-house data processing capabilities exist, and thus it seems eminently reasonable that a school system's initial engagement with in-house computer usage be moderate and restricted to mark reporting. This initial application might be achieved with relative ease, but it will assuredly require many hours of in-service training for staffs during which such factors as new input and output interpretation, operational characteristics and data preparation would have to be considered.

Simultaneously, the school system should experiment with other essentially administrative data processing activities which would soon come within the scope of the computer facility. One such activity is that of student scheduling and its unique demands will require not only the procedural re-orientation common to mark-reporting, but will require as well a philosophical re-orientation toward the concept of student scheduling. Depending upon the time of year that the computer facility is to be installed a decision must be made by the school, either to proceed with the previous scheduling arrangements through its service bureau, or to provide in-house student scheduling. This decision must be made knowing in advance that school will open in September.

Phase 2 *Adding Remote Teletype Terminals and Related Software*

To provide on-line interactive access, the following computer hardware and software, for example, would be necessary:

Phase 1 Hardware Configuration plus the addition of
Four Remote Terminals and Related Hardware
BASIC Language
TOTAL COST per month $3200.00

Phase 1 established the computer facility with an essentially administrative data processing function and at the same time provided for limited student access. With the implementation of Phase 2, student access would be increased dramatically by the addition of four remote, interactive teletype terminals, thereby permitting students to interact with the computer facility from remote locations. With the addition of these terminals, schools would be able to offer additional opportunities to their students, faculty, staff and administrators for the application of computers in the course of their work.

Phase 3 *Expanding to a Multi-Programming Environment*

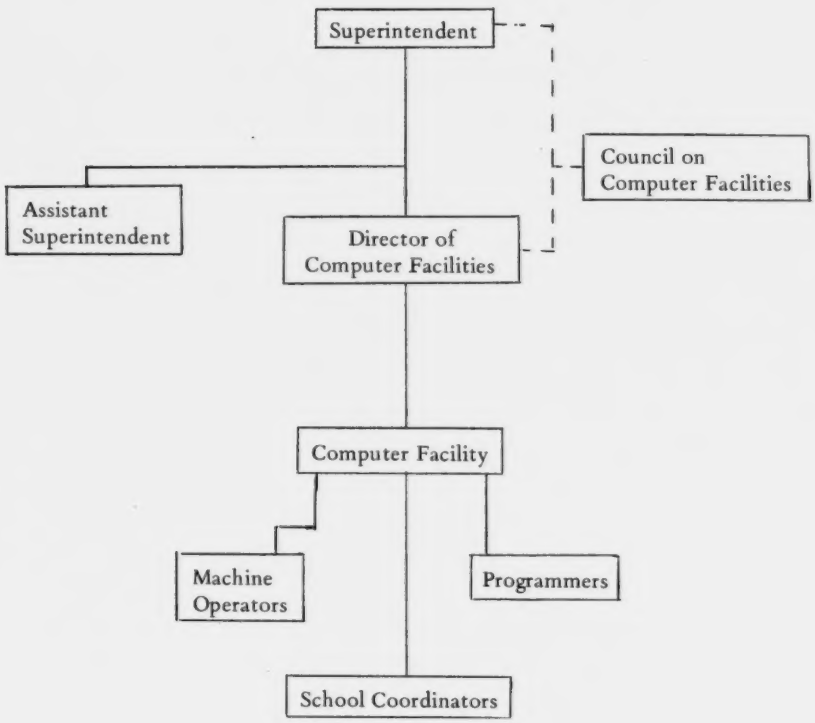
The following computer hardware is an example of the Phase 3 stage of development.

Phase 2 Hardware Configuration plus the
Addition of 16K Byte Memory
Multi-Programming Capability
TOTAL COST per month $3700.00

The addition of 16K Byte memory expands the facility to include multiprogramming capabilities. Students will be able to interact with the computer for instructional purposes, while at the same time the administration may be interacting with it for data processing purposes.

With the implementation of Phase 3, schools will have a powerful and versatile computer facility employing the latest computer technology. Its design and capabilities make it suitable as an instructional computer system as well as a business system. Schools will have the essential items for total in-house control over its data processing and enough flexibility with auxiliary devices, software packages, and applications to attain its objective of having a computer system that could be used as a tool for both instructional purposes and administrative data processing.

APPENDIX



ORGANIZATIONAL CHART

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